Rebuild Hawaii
Energy $mart Schools Project

Final Report

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Executive Summary

The Energy $mart Schools Project is a Rebuild Hawaii project managed by Hawaiian Electric Company, Inc. (HECO) to train high school students to perform energy audits in school buildings and neighboring small businesses while experiencing real-life work opportunities. The project was developed through a Rebuild Hawaii partnership to increase energy awareness in Hawaii's public schools and small businesses. The partnership includes the State of Hawaii Department of Business, Economic Development and Tourism (DBEDT), the U.S. Department of Energy and Hawaiian Electric Company, Inc. and is sponsored by the Rebuild Hawaii Consortium.

Energy $mart Schools was conducted as a multidisciplinary energy conservation project to incorporate hands-on math, science, computer, marketing, advertising and public speaking instruction. Special instructors and/or guest speakers were assigned to work with the students once a week for 20 weeks. Students were taught how electricity is produced and distributed. They learned how to perform energy audits by applying critical thinking, problem solving and decision-making. The learned presentation skills and demonstrated the benefits of lighting retrofits in school buildings.

On Oahu, students at Kalaheo and Waianae High Schools were educated in energy conservation methods and trained in lighting audit procedures using state of the art auditing devices. They identified the need for their schools to utilize energy more efficiently, to save money and to improve the quality of the lighting. The easiest way to meet this need is to retrofit the existing lighting system to energy efficient T8 lamps with electronic ballasts. Generally speaking, the retrofit would reduce the lighting consumption by 30%.

The students conducted lighting audits at their schools and presented the results in a PowerPoint format to the schools' administration, parent teacher organizations, classmates and state and federal government agencies. The students' work was also presented before the State of Hawaii Department of Education's Board and the 2001 Legislature.

Students' Results: Potential Energy Savings After Lighting Retrofit

School	School Size	Annual Energy Savings After Retrofit	Annual Cost Savings After Retrofit
Kalaheo High School	122,952 sq ft	161,619 kWh	$16,323
Waianae High Schools	101,080 sq ft	217,046 kWh	$21,922
Total		**378,665 kWh**	**$38,245**

The students learned the relationship between math and science applications of energy audits and took their knowledge and skills to the private business sector. Before doing so, they spent class time learning about marketing and advertising procedures and developed business presentation skills. They increased community awareness of energy conservation and energy efficiency in Hawaii by performing energy audits at small business sites. The teenagers called on neighborhood businesses using brochures/flyers and calling cards. They presented the Energy $mart awareness project to business owners, and received invitations to conduct lighting audits at the stores and offices. The young auditors looked at retrofitting T12 fluorescent lamps and magnetic ballasts with energy efficient T8 lamps and electronic ballasts. After calculating the results of the audit using actual energy calculations, material and labor costs and including the utility rebate, the students presented their findings to the small businesses.

Funding for the project was provided by HECO and Rebuild Hawaii, a U.S. Department of Energy consortium that facilitates energy-saving programs.

Due to the success of the project and with support from the teachers and school administrators, Energy $mart Schools will be repeated at two additional high schools on Oahu in 2002. The project can be easily replicated at other Hawaii schools and on the Continental U.S.

The following report is written in a procedural format so schools can use it as a step by step guide to incorporate the Energy $mart School project at their facilities.

Introduction

The Rebuild America Program of the U.S. Department of Energy encourages K-12 educational programs to conduct energy conservation studies and instigate implementation. Hawaiian Electric Company, Inc. (HECO), with support from Rebuild Hawaii and the State of Hawaii Department of Business, Economic Development, and Tourism (DBEDT) and the Rebuild Hawaii Consortium, initiated the Energy $mart Schools project.

The Energy $mart Schools project goal is to heighten awareness and increase energy-efficiency in public schools and private small businesses while simultaneously giving high school students hands-on training in the fields of energy management (specifically lighting), business, marketing, advertising and computer technology.

This report summarizes HECO's development and implementation of an Energy $mart Schools pilot project. The report will provide recommendations and procedures for replicating the project.

The Energy $mart Schools project accomplished the following:

- Obtained participation from 2 public high schools
- Developed marketing pieces to inform teachers about the project, and prepared an educational syllabus;
- Conducted 20 workshops for high school students;
- Assisted students with determining no-cost/low-cost energy measures in their homes and at school
- Taught students basic energy concepts
- Trained students in lighting audit skills
- Assisted students with the practical application of lighting audit concepts within their high schools;
- Assisted students with developing a presentation for the school administration discussing the school audit results;
- Obtained the donation of material and labor from Energy Conservation Hawaii (a Rebuild Hawaii Business Partner) GE Lighting Hawaii, and Graybar Electric Supply Co. Hawaii for a classroom retrofit, saving the school $360 annually;
- Prepared marketing flyers to solicit the student auditing services;
- Assisted students in contacting and coordinating 20 small businesses to perform energy audits; and
- Students received $50 for every business audit they completed.

- Opened doors to the Board of Education and Legislation to allow us the time to present the project and explain the possible energy savings by conducting lighting retrofits at the schools

1. High School Participation

Marketing Tools

HECO developed two marketing flyers to solicit school participation in the Energy $mart Schools project. HECO designed one flyer targeting the teachers (Appendix 1-1) and the other targeting the students (Appendix 1-2). HECO distributed the teacher's flyer to twenty-six public high schools on Oahu. Developed especially for the targeted markets, each flyer explained the background, purpose, and rewards of the Energy $mart Schools project. The student flyer was meant to interest the children and also to inform their parents about the special project the students were going to undertake.

Workshop Syllabus

To prepare a 20 week class syllabus, HECO investigated energy awareness programs currently being used in schools across the nation. Some of these programs provide quality, free materials on the Internet. HECO used lesson plans and worksheets from the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EREN) and Alliance to Save Energy (Alliance). The website addresses are: http:www.eren.doe.gov/energysmartschools and http:www.ase.org/

HECO prepared a draft syllabus of workshop activities to share with the teachers (Appendix 1-3). The teachers reviewed the draft syllabus and shared additional input. The workshop syllabus covered activities from energy and electricity background to lighting audit training.

Project Adoption by Schools

Four interested teachers contacted HECO's School Coordinator. The first two teachers who made the commitment to participate in the project were selected. Those schools were Kalaheo and Waianae High Schools.

HECO met with each teacher to schedule workshop times that would work with each school's schedule. It was left it up the teachers to determine if they wanted to have workshops after school in a 'club' format, or during the regular school day. Both teachers choose to hold the workshops one period a week, during the regular school day. One teacher selected their Physics class and the other choose the Chemistry class. Each class, or workshop, lasted from one to one-and-one-half hours. See Meeting Reports (Appendix 1-4).

Letters of Commitment (Appendix 1-5) were developed by HECO and executed by the teachers. These two individual schools did not require the principals' approval in writing to proceed with plans.

2) **Workshops**

Workshop Instructional Materials
For course preparation, HECO used actual working documentation that is in use within the utility's Energy Services Demand Side Management program. Other worksheets and handouts were prepared specifically for the students in this project.

Printed instructional material from HECO included (Appendix 2-1 through 2-12):

- *Energy Tips and Choices* booklet
- *Input Wattage for Various T8 Lighting Systems* handout
- *Lighting Equipment Survey* worksheet
- *Survey Recapitulation worksheet*
- *Savings Calculations* handout
- *Directions for Entering Data on T8 Worksheets*
- *Excel T8 Audit Energy Savings Worksheet*
- *Excel T8 Audit Prices and Rebates Worksheet*
- *T8 vs. T12* handout
- *Student Presentation on School Audits* worksheet
- *Student Plan for Small Business Audit* worksheet
- *Small Business Promotional Marketing Flyer*

Worksheets from EREN Internet site included (Appendix 2-13):

- *Pre and Post Test*

Worksheets from the Alliance Internet site included (Appendix 2-14 through 2-20):

- *The Electric Hookup*
- *Wattage Ratings*
- *Appliance Energy Use*
- *How Much Energy Do You Use?*
- *Energy Home Survey*
- *Meter Reading*
- *How to Read Your Meter*

Energy Demonstration Kit
Hands-on learning was very important in this program so a variety of 'field work' items were purchased to use in the classroom as well as during the audits. While the students were not allowed to touch the fixtures at any time, hardware was used during professional demonstrations. Description of the material can be found in Appendix 2-21. Using the

digital camera and the laptop, students took pictures of the material and loaded it into the computer for inclusion in this report (Appendix 2-22).

- 1 laptop computer
- 1 portable printer
- 1 digital camera
- 1 light meter
- 5 lighting loggers
- 1 flicker checker
- 1 pocket monocular
- 1 Electrowizard Inventions Kit
- Various motor supplies
- 1 ladder
- 1 KW meter
- 3 screwdrivers
- 2 small pliers
- 4 T8 and T12 lamps and hardware
- 5 Misc. CFL

Workshop – Introduction to Energy and Electricity
An electrical engineer from HECO's Energy Services Division instructed students on energy conservation, electrical generation, electrical delivery and consumer utilization.

Students learned where the 6 major generators are on Oahu and the 4 types of generators working on the island (oil fired boilers, coal fired boilers, garbage fired boiler and oil fired combustion turbine).

They discussed the delivery system, from transmission lines to substations, to distribution lines, transformers to metered home service.

The workshop reviewed the items utilizing electricity in the home and office and covered the importance of choosing high efficient appliances and turning lights and electronics off when they are not needed.

Workshop - Student Marketing and Presentation Skills
HECO's Energy $mart Schools Program Manager conducted a workshop on advertising, marketing and presentation skills.

The lecture included basic advertising design, marketing strategies and presentation techniques to gain involvement from businesses. The HECO manager developed and implemented HECO's national award-winning Energy Solutions for Small Business project (a Rebuild Hawaii project that markets energy efficiency to small businesses on

Oahu.) The class covered creating flyers/brochures to motivate neighborhood businesses to allow the students to conduct energy audits in their workplace. Audit presentation forms, flyers and brochures used in the Energy Solutions for Small Business project were given to the students for their individual modifications.

The HECO project manager worked with the students in preparing their telephone presentation speech to obtain the first meeting with the small business owner. Students were also counseled on business etiquette such as handling telephone rejection from cold-calls, how to dress for a meeting, how to greet a potential customer and general business conduct tips.

Weekly Reports
To facilitate future projects and for the ease of replication, reports covering the workshop activities and recommendations for changes in future workshops were kept on a weekly basis (Appendix 2-23).

Class List
Fifty students participated in the Energy $mart Schools project. Thirty-two students were in the Kalaheo High Physics class and eighteen students sat in at the Waianae High Chemistry class (Appendix 2-24).

Teacher Survey
After the final workshop, the classroom teachers, Jim Redmond and Michele Hauschulz completed a survey prepared by HECO (Appendix 2-25 through 2-28). The survey asked questions regarding the effectiveness of the Energy $mart Schools project and asked for recommendations on ways to improve the project for the next implementation.

3 Lighting Audit Training

Fluorescent Lighting Identification
HECO trained students to identify different types of fluorescent light fixtures. A HECO lighting specialist conducted a workshop using the Energy Demonstration Kit. The workshop covered identifying light fixtures, ballasts, lamps, and lenses. The instructor climbed a ladder to open a ceiling light fixture in the classroom to point out the parts of the fixture. He showed students the differences between T12 and T8 fluorescent lamps. Students learned to use a flicker checker to identify whether a light fixture has magnetic or electronic ballast. The discussion covered de-lamping and tandem wiring light fixtures as additional ways to improve energy efficiency in lighting retrofits.

School Building Lighting Audits
The students were trained to conduct lighting audits by counting the fixtures in the buildings of their school. They started with their classroom and school library. Students formed small groups then gathered data on the number of fluorescent light fixtures, lamps, and burn hours. Students recorded their data on the *Lighting Equipment Survey*

worksheets. Students took pictures with the digital camera to record the types of light fixtures they found in their schools. Waianae High School students audited their classroom, computer rooms, administrative office and library. Kalaheo High School students audited their whole school and were surprised to discover that their gym did not qualify because it didn't have any T12's. The actual recapitulation of the audit produced by the students can be found in Appendix 3-1.

To understand the energy and electrical costs at their schools, the students studied their schools' historical energy usage for the previous 2 years (Appendix 3-2). When reviewing the months with higher bills they discussed what could have been going on in the school at that time period to cause the increase.

The students assessed how much energy was being used for lighting in a selected room or building by applying lighting loggers in selected fixtures. The loggers were installed for one school week, removed and the results were printed out. While reviewing the printout, classroom discussions covered reasons why the lighting logger graph showed 100% to 20% usage (Appendix 3-3). Kalaheo choose to run the lighting loggers in their classroom. The Waianae students installed their loggers in the main office were able to see on their graph when someone came into the office on 4/7/00 while the school was closed.

HECO Software
HECO taught the students how to use a Microsoft Excel spreadsheet software developed by HECO for its *Energy Solutions for Small Business program*. The students learned to manipulate the information to calculate energy and cost savings by replacing T12 lamps and magnetic ballasts with T8 lamps and electric ballasts. The spreadsheet also helped the students calculate lighting retrofit costs and potential payback periods.

The students entered their school audit data into the Excel program on the laptop computer. They generated audit reports and then reviewed the reports results via class discussions.

4. Lighting Audit Presentations

Presentation Preparation
With school lighting audits complete, students prepared their documents for the school presentations. They developed outlines to summarize the results of the school lighting audits. The students gathered background information on their schools by interviewing office and custodial staff. Continued preparation included students organizing the photos they took 'in the field' with the digital camera, preparing the Excel software worksheet tables, and integrating the lighting logger graphs in Power Point. Much of the studies and paperwork previously developed by the students in the workshops were used in their PowerPoint slide presentation (Appendix 4-1 and 4-2). Students had a chance to learn

the popular software and experiment with the graphics, graphic motion and audio enhancements.

As a committee, the students decided which teams would decide what information would be included in the presentation, which team would create the PowerPoint slides, who would operate the equipment and which students would stand before the audience and present. They practiced presenting to each other and in front of their teachers. They made modifications as they rehearsed and prepared for the formal presentation.

Student Presentations
The students presented their PowerPoint presentations at Parent, Teacher, Student Association (PTSA) meetings and a Hawaiian Studies meeting. The school principals, vice-principals, teachers, parents, U.S. Department of Education, Hawaii Department of Business & Economic Development and HECO representatives and members of Rebuild America attended the meetings. The Kalaheo students were fortunate to present their project to Mr. Peter Dreyfuss, Deputy Chief of Staff, Energy Efficiency and Renewable Energy, U. S. Department of Energy.

HECO Presentations
HECO presented the Energy $mart Schools project at a Board of Education meeting at the Queen Liliuokalani Building in August of 2000. Representatives from HECO showed the board members the results from the students' school building audits and the energy savings that could be achieved if lighting retrofits were conducted. Since the meeting was during the summer the students were not available to help present.

At a Rebuild America Peer Exchange Meeting in December of 2000, the Energy $mart schools project was presented as a case study to the west coast division of Rebuild America. The Energy $mart School instructor, the HECO program manager and the Waianae teacher and student presented the hour-long case study. The student's presentation was so heartfelt she made every Rebuild member proud of her accomplishments.

The Hawaii State Department of Accounting and General Services (DAGS) invited HECO to present the project and demonstrate the schools' energy savings to the Budget and Finance meeting at the 2001 Legislature.

At DAGS' invitation, HECO also presented the project at the Honolulu Vice Principal Quarterly Meeting in 2001.

5. Lighting Vendor Donation
The Energy $mart Schools Project received help from a lighting contractor and Rebuild Hawaii Business Partner, Energy Conservation Hawaii (ECH). They retrofitted the lights in one of the classrooms audited by the students at Kalaheo High School (room H205).

ECH used the students' specs to cost out the project. ECH donated time and labor. GE Lighting Hawaii and Graybar Electric Supply Company Hawaii donated the T8 lamps and electric ballasts. See backup correspondence regarding this procedure in Appendix 5-1, 5-2 and 5-3.

The classroom will demonstrate the use of energy efficient lighting in a school. It is estimated that the Kalaheo High School Classroom H-205 will save the school $360 each year just from retrofitting their 44 fixtures. The students estimate that the new lights will save 3,600 kWh per year.

A press release was distributed promoting the Energy $mart School project and the contributions made by Energy Conservation Hawaii and its supporters (Appendix 5-4).

Hawaiian Electric Company, Inc. gave the school $246 as an energy efficient rebate. This type of utility rebate is available to all Oahu schools that retrofit their fluorescent lights according to HECO's program.

6. Small Businesses Lighting Audits

Small Business Participation
Students took their marketing training and lighting audit experience to neighboring small businesses. Their goal was to educate them about energy conservation measures, conduct a lighting audit and show them how they could save money by retrofitting to T8 lamps with electronic ballasts. Flyers created by the students were handed out to the small business owners and managers asking them to allow the students to conduct a free lighting audit. (Appendix 6-1, 6-2, 6-3).

To attract additional interest from small businesses, and to lend credence to the student's solicitation, HECO ran an article on the project in the utility's monthly bill stuffer, *Consumer Lines*, reaching approximately 250,000 Oahu customers (Appendix 6-4). Concurrently, HECO prepared and distributed a media release describing the Energy $mart Schools project and enlisted small business participation (Appendix 6-4, 6-5).

Small Business Audits
The students formed auditing teams. The teams did everything together, but divided the responsibilities, i.e. salesperson, auditor, computer data entry, final presenter.

The 'salespeople' contacted the small businesses in a variety of ways. Some made cold-calls by telephone while others canvassed shopping centers or office buildings and distributed the marketing flyer. In some cases, students coordinated with relatives that owned or worked in a small business. Each team of student auditors was successful in securing an audit.

During the audit the students explained the energy and cost benefits of retrofitting the operation's lighting to T8 lamps with electronic ballasts. After the short meeting, the auditing team proceeded to count the fixtures on the property. The business owner was informed that they would receive their audit results at another time in the near future.

Small Business Reports

The students returned to school with the lighting audit data and inputted the raw information into the HECO Excel spreadsheets. The information was printed out and the students shared the results with the small businesses. The reports contained one worksheet on projected energy savings and one worksheet on projected costs to retrofit to T8 lamps and electric ballasts (Appendix 6-7, 6-8). As a special touch, the students left 'calling cards' when making the presentation. This gave the business owner a contact number to call in case they were interested in pursuing the lighting retrofit (Appendix 6-9).

A compilation of all 20 audits was produced for the students to compare the different lighting usage at the various companies (Appendix 6-10). Comparisons included number of fixtures, kWh savings per year, annual estimated savings and net project costs. Comparing the burn hours in reference to speed of payback was an important factor.

Twenty small businesses received free lighting audits. Waianae High School students completed 8 lighting audits and Kalaheo High School students completed 12. The class was given $50 for each audit performed. The students were given the opportunity to spend the money any way they wanted, as long as everyone in the class was in agreement. They choose to reward themselves individually with the money and could either keep the money or donate a part or the whole amount to organizations at the school.

At the end of the semester, a telephone survey was conducted to ascertain the small business' reaction to their participation in the project (Appendix 6-11, 6-12). The goal to heighten business' awareness of possible energy savings was achieved. While their rate in retrofitting was less than anticipated, the school link with the community was a valuable experience on both students' and business' behalf.

7. Lessons Learned

Workshops

If a workshop involves some math, make sure to allow for extra time during the class to walk students through the calculations step-by-step. Taking mathematical concepts off of the page and into actual implementation is a big step.

Waianae High School students fit in some extra computer lab time to work with the Excel T8 worksheets. This helped a lot when it came time for students to enter in the data from the library audits. The students were much more confident using the worksheets.

Plan at least two workshops inside the computer lab for students to design the small business flyers. The students needed extra time to design and organize their flyers. Using a software program the students have access to at home or in their classroom will enable them to work on the project for a period of time longer than the lab can provide. The software of choice was Appleworks and Microsoft Word.

School Lighting Audits
During the school lighting audits, keep the size of student groups small, approximately 4-6 students per group. Smaller groups work together better and are generally quieter than larger groups.

For a more productive meeting at the school office, be sure to make arrangements with the office ahead of time. Let them know the kinds of question that may be asked of them, such as who pays the electric bill, how many different bills they receive and the estimated cost.

Presentations
Plan for some additional workshop time in the school computer lab for students to prepare their PowerPoint presentations. The actual working time during a workshop in the computer lab is shorter than other workshops because students have to walk from class to the computer lab. Instructor should start up the computers before class in an effort to save time. The work should be saved on disc and not the hard drive.

Small Business Retrofits
While the small businesses were very helpful in working with the students, they were very hesitant to discuss possible retrofitting. Many of the stores were in repressed neighborhoods, and at the time of the audits the owners were looking at potential tax increases. In the next $mart Schools project, we need to look at ways to encourage the more potential customers to take energy efficient measures. Rather than having the instructor make the telephone survey, the HECO program manager should call and lead the businessperson into the next step.

8. Future Implementation

Due to the success of this project, funds have been granted to continue the $mart Schools project. There is interest from teachers at other schools and one of the current teachers is willing to participate again (the Kalaheo teacher has since moved to another state). Although the first classes are over, we are still working with the schools and small businesses to initiate the energy efficient measures.

9. Publicity

The Energy $mart Schools received publicity in the local newspaper and in the HECO bill stuffer *Consumer Lines* (Appendix 6-4, 6-6). Other articles regarding the program appear in the Rebuild Hawaii newsletter and in the Waianae High School Hawaiian Studies Program newsletter (Appendix 6-12, 6-13).

10. Conclusion

The first two Energy $mart Schools classes were a great success. This is due to the teachers' guidance and their allowing us to bring instructors and special speakers on campus and follow or amend the draft syllabus as necessary. Their principals were very supportive and allowed the teachers to do what they felt worked best. The project would not have been as successful without the teachers and administrators' support.

Having the subject matter presented during regular class time rather than as an after-school project was very beneficial. If we had the program as an after-school activity, we may not have reached as many children. Some would have been involved in sports, or other after-school functions. But most importantly, we reached some students who just don't care to participate in extra-curricular programs. Besides the classroom lessons learned in the Energy $mart Schools project the children were exposure to real-life work situations. What these students accomplished was extra-ordinary.